

# Applied Quantitative Methods to Analyse Business Data



SYLLABUS

VU Amsterdam Summer School

22 July – 2 August 2024



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Any general questions for the Summer School support team? Contact [amsterdamsummerschool@vu.nl](mailto:amsterdamsummerschool@vu.nl).

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## 1. CORE INFORMATION

Course Name	Applied Quantitative Methods to Analyse Business Data	
Credits	3 ECTS	
Teachers	Prof. Dr. Nico Schauerte	<a href="mailto:n.schauerte@vu.nl">n.schauerte@vu.nl</a>
	<i>Course Coordinator, Lecturer, Tutor</i>	

## 2. INTRODUCTION

We take an applied perspective on data analytics for businesses, emphasizing methods to evaluate different types of data that managers encounter in their every-day work (e.g., customer purchase data, surveys, website data).

### Course description

The course focuses on quantitative applications to real-world business data, teaching students econometric methods (principles of statistical testing, multiple linear regression, logistic regression, time series regression, panel data analysis) and implementation of these methods (skill development) in the statistic software R.

Students will get to know different types of company data (cross-sectional, longitudinal, panel data), learn the basic frequentist approach to statistical test theory, and be introduced to the main workhorses of causal analysis. They will gather theoretical knowledge about these methods, their assumptions, and remedies to violations of these assumptions. Furthermore, students will apply this knowledge practically to data provided from openly available case studies and proprietary records from collaborating companies using the free statistical software R. Finally, academic articles applying the introduced methods teach students comprehension and interpretation of econometric research. Thus, (1) econometric knowledge, (2) implementation skills, and (3) understanding of empirical academic procedures are the main objectives of this course.

### Course Structure

The course follows a lecture-application sequence, with six major topics:

#### A. Motivation and Statistical Background (Day 1)

- (1) Introduction
- (2) Principles of statistical testing

#### B. Refresher: Analysis of Surveys and (Field) Experiments (Days 1-4)




- (3) Multiple linear regression (continuous outcome; cross-sectional data)
- (4) Logistic regression (binary outcome; cross-sectional data)

#### C. Main Focus: Analysis of Observational Data (Days 5-10)

- (5) Time series regression (continuous outcome; longitudinal data)
- (6) Panel data analysis (continuous outcome; longitudinal data)

### 3. LEARNING OBJECTIVES

The course aims to convey useful econometric skills to analyze different forms of business data that managers handle on a day-to-day basis. Theoretical background knowledge, practical (software-based) application, as well as substantive interpretation of results and implementation to a business context all stand at the forefront. Sufficient amounts of theory are integrated as necessary requirements to understand method applications; however, this is not an econometric theory course, focusing instead of statistical depth of understanding on the practical applicability of causal analysis approaches. We put forth the following learning objectives: knowledge, bridging theory and practice, and application skills. After successfully completing the marketing strategy course, you will be able to:

	Have thorough knowledge of relevant (basic) theory and methods
<ol style="list-style-type: none"> <li>(1) Gain insights on business data science from a hands-on, applied point of view e.g., by understanding when to use which analysis method and what assumptions it requires</li> <li>(2) Understand foundational statistical knowledge useful to apply and interpret analysis methods in real-world contexts</li> </ol>	
	Use the theoretical knowledge to effectively solve complex business problems with quantitative methods
<ol style="list-style-type: none"> <li>(3) Abstract information and structure knowledge from practical, real-life cases</li> <li>(4) Recognize problem structures and apply conceptual knowledge gained from the econometric textbooks and articles in the management and marketing disciplines by <ul style="list-style-type: none"> <li>• discussing the types of data that are reflected in a case study or a company database,</li> <li>• identifying relevant variables and appropriate methods to build a pragmatic but rigorous model, and</li> <li>• iteratively specify and compare appropriate models for managerial decision-making.</li> </ul> </li> </ol>	
	Have the advanced research and software skills to implement data analyses and draw conclusions from their results
<ol style="list-style-type: none"> <li>(5) Code your model(s) in the widely used and powerful analysis software R</li> <li>(6) Test and interpret model results based on the requirements of the different data types</li> </ol>	

### 4. LITERATURE

Lecture Slides	The plenary lecture slides are part of the mandatory literature. Slides of the plenary lectures will be provided either in-class or as <b>short knowledge clips</b> before the start of each lecture via Canvas.
Download articles	All articles can be retrieved via the library of the University, unless otherwise noted on Canvas. <a href="https://www.ub.vu.nl/en/">https://www.ub.vu.nl/en/</a> Note that you can access the library from your home computer. See: <a href="http://www.ubvu.vu.nl">www.ubvu.vu.nl</a> > Facilities > Working from home
Literature	<ul style="list-style-type: none"> <li>• Papiés, Dominik, Peter Ebbes, and Harald Van Heerde (2016), "Addressing Endogeneity in Marketing Models," in: Leeflang, Peter et al. (eds.), <i>Advanced Methods for Modeling Markets</i>, International Series in Quantitative Marketing, 581-627.</li> </ul>

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- Rossi, Peter (2017), “Even the Rich Can Make Themselves Poor: A Critical Examination of IV Methods in Marketing Applications,” *Marketing Science*, 33(5), 655-572.
  - Binken, Jeroen L.G. , and Stefan Stremersch (2009), “The Effect of Superstar Software on Hardware Sales in System Markets,” *Journal of Marketing*, 73(2), 88-104.
  - Gill, Manpreet, Shrihari Sridhar, and Rajdeep Grewal (2018), “Return on Engagement Initiatives: A Study of a Business-to-Business Mobile App,” *Journal of Marketing*, 81(3), 45-66.
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## 5. ASSESSMENT OVERVIEW

### General requirements

- When attending the sessions, students are expected to have read the assigned literature in advance and familiarized themselves with the data. Note that students are expected to attend all sessions.
- When attending the sessions, each student is required to actively participate in the class discussion.
- Each student is furthermore required to submit the coding assignments provided during class. These assignments, submitted as R code, will be the main deliverable for grading.

### Coding assignments

- Instead of a written exam, students are required to work in groups of two on the coding assignments in-class and submit their R-code in several steps during each tutorial. Details will be discussed in the first session.
- Students are furthermore—and in addition to the in-class step-by-step submissions—required to submit a clean code that runs smoothly and yields the correct results by the end of each of the four chapters (linear regression, logistic regression, time series analysis, panel data analysis).
  - ✓ In-class assignments (submitted R code is basis for individual grading)
  - ✓ Chapter-specific R-code summary (submission mandatory; not graded)

To pass the course, an average grade of 5.50 or higher must be obtained for the group assignments.

## 6. DETAILED COURSE SCHEDULE

### CLASS HOURS

Week 1		Week 2	
Monday, July 22	10.00 – 14.00h	Monday, July 29	9.00 – 14.00h
Tuesday, July 23	10.00 – 14.00h	Tuesday, July 30	9.00 – 14.00h
Wednesday, July 24	10.00 – 12.00h	Wednesday, July 31	9.00 – 12.00h
Thursday, July 25	10.00 – 14.00h	Thursday, August 1	9.00 – 14.00h
Friday, July 26	9.00 – 14.00h	Friday, August 2	9.00 – 14.00h

Topic	Date	Content	Preparation
1	<b>CAUSAL ANALYSIS</b>		
	Monday, July 22  10.00-12:00h	<b>LECTURE 1 (2h)</b> <ul style="list-style-type: none"> <li>• Organization of the course</li> <li>• The fundamentals of causal analysis <ul style="list-style-type: none"> <li>• Causal identification</li> <li>• Statistical testing</li> </ul> </li> </ul>	<b>Work through the articles</b> <ul style="list-style-type: none"> <li>• Rossi et al. (2017)</li> <li>• Papies, Ebbes, and Van Heerde (2016)</li> </ul>
2	<b>LINEAR REGRESSION (Data: Store 24)</b>		
	Monday, July 22  12:00-14:00h	<b>LECTURE 2 (2h)</b> <ul style="list-style-type: none"> <li>• Linear regression (Part 1)</li> </ul>	
	Tuesday, July 23  10.00-14.00h	<b>LECTURE 3 (2h)</b> <ul style="list-style-type: none"> <li>• Linear regression (Part 2)</li> </ul> <b>INTERACTIVE SOFTWARE TUTORIAL (2h)</b> <ul style="list-style-type: none"> <li>• Case linear regression: Store 24</li> </ul>	<b>Work through the case</b> <i>Store 24</i>
3	<b>LOGISTIC REGRESSION (Data: Service Technicians as a "Second" Salesforce)</b>		
	Wednesday, July 24  10.00-12.00h	<b>LECTURE 3 (2h)</b> <ul style="list-style-type: none"> <li>• Logistic regression</li> </ul>	
	Thursday, July 25  10.00-14.00h	<b>INTERACTIVE SOFTWARE TUTORIAL (4h)</b> <ul style="list-style-type: none"> <li>• Case logistic regression: <i>Service Technicians as a "Second" Salesforce</i></li> </ul>	<b>Work through the case</b> <i>Service Technicians as a "Second" Salesforce</i>
4	<b>TIME-SERIES ANALYSIS (Data: Digital Service Communities)</b>		
	Friday, July 26  9.00-14.00h	<b>LECTURE 4 (2h)</b> <ul style="list-style-type: none"> <li>• Introduction to time series analysis</li> </ul> <b>INTERACTIVE SOFTWARE TUTORIAL (3h)</b> <ul style="list-style-type: none"> <li>• Case basic time series analysis <i>Can a Digital Service Community Relieve Call Centers Yet Lift Service Performance?</i></li> </ul>	<b>Work through the case</b> <i>Can a Digital Service Community Relieve Call Centers Yet Lift Service Performance?</i>
	Monday, July 29  9.00-14.00h	<b>LECTURE 5 (2h)</b> <ul style="list-style-type: none"> <li>• Advanced time-series analysis <ul style="list-style-type: none"> <li>- Serial correlation &amp; robust standard errors</li> <li>- Modeling dynamics</li> </ul> </li> </ul> <b>INTERACTIVE SOFTWARE TUTORIAL (3h)</b> <ul style="list-style-type: none"> <li>• Case dynamic models <i>Can a Digital Service Community Relieve Call Centers Yet Lift Service Performance?</i></li> </ul>	<b>Work through the article</b> Binken and Stremersch (2009)
5	<b>PANEL DATA ANALYSIS (Data: Indulge in Redemption &amp; Launching Disney+)</b>		
	Tuesday, July 30  9.00-14.00h	<b>LECTURE 6 (2h)</b> <ul style="list-style-type: none"> <li>• Introduction to panel data analysis</li> </ul> <b>INTERACTIVE SOFTWARE TUTORIAL (3h)</b> <ul style="list-style-type: none"> <li>• Case basic panel data analysis: <i>Indulge in Redemption?</i></li> </ul>	<b>Work through the case</b> <i>Indulge in Redemption?</i>
	Wednesday, July 31  9.00-12.00h	<b>LECTURE 8 (2h)</b> <ul style="list-style-type: none"> <li>• Serial correlation &amp; clustered standard errors in panel models</li> </ul> <b>INTERACTIVE SOFTWARE TUTORIAL (1h)</b>	<b>Work through the case</b> <i>Indulge in Redemption?</i>

		<ul style="list-style-type: none"> <li>• Case basic panel data analysis <i>Indulge in Redemption?</i></li> </ul>	
Thursday, August 1	9.00-14.00h	<p><b>LECTURE 8 (2h)</b></p> <ul style="list-style-type: none"> <li>• Advanced panel data analysis <ul style="list-style-type: none"> <li>- Modeling panel dynamics</li> <li>- Panel error correction model (PECM)</li> </ul> </li> </ul> <p><b>INTERACTIVE SOFTWARE TUTORIAL (3h)</b></p> <ul style="list-style-type: none"> <li>• Case dynamic panel models <i>Indulge in Redemption?</i></li> </ul>	<p><b>Work through the case</b> <i>Launching Disney+</i></p>
Friday, August 2	9.00-14.00h	<p><b>LECTURE 7 (2h)</b></p> <ul style="list-style-type: none"> <li>• Advanced panel data analysis <ul style="list-style-type: none"> <li>- Self-selection</li> <li>- Difference-in-Differences (DiD) models</li> </ul> </li> </ul> <p><b>INTERACTIVE SOFTWARE TUTORIAL (2h)</b></p> <ul style="list-style-type: none"> <li>• Case (self-)selection (&amp; DiD estimation) <i>Launching Disney+</i></li> </ul> <p><b>WRAP-UP: Q&amp;A + EVALUATIONS (1h)</b></p>	<p><b>Work through the case</b> <i>Launching Disney+</i></p> <p><b>Work through the article:</b> Gill, Sridhar, and Grewal (2018)</p>

## 7. DETAILED DESCRIPTION OF THE TUTORIALS

We will work in teams of two students on real-world business cases with secondary datasets provided by different companies and customer primary data, respectively. In each tutorial, we will use the newly acquired data analysis skills to iteratively solve the case. That is, we go through it step-by-step, tackling one question of the case at a time, discuss student solutions, and provide an “ideal” solution, before going on to the next question. Specifically, we

- First, present the case and its background
- Second, introduce the first assignment
- Third, work on the assignment in-class using the statistical software R
- Fourth, briefly present student solutions
- Fifth, briefly present an “ideal” solution
- Sixth, go on to the next assignment.

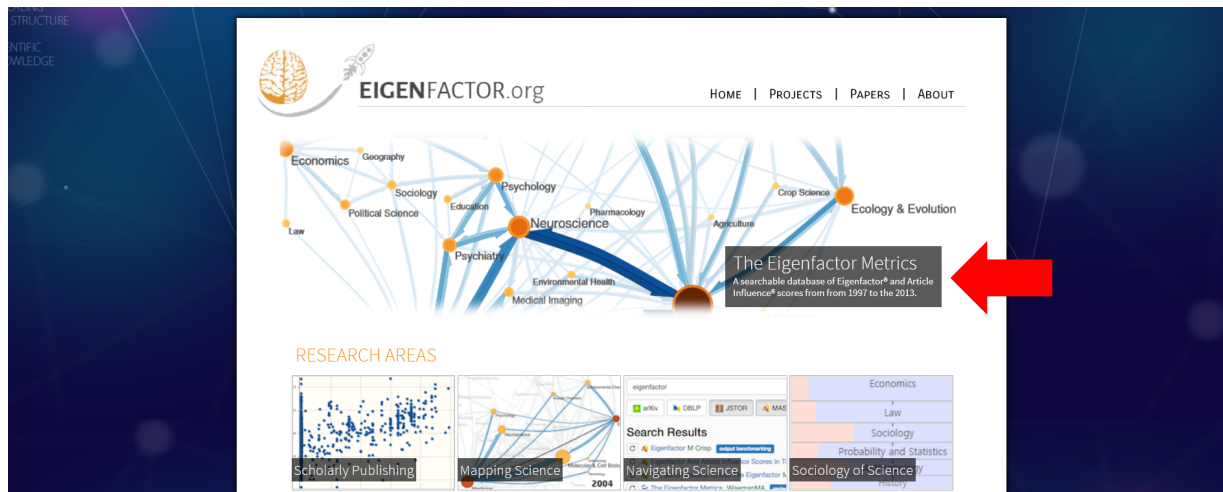
This way, we aim to get everybody on the same page, understanding how to solve the assignment before moving on to the next (typically more challenging) one.



## 8. JOURNAL QUALITY

The academic articles you use should be of a certain quality level. Different journals are evaluated at different quality levels depending on their relevance and rigor. This might be difficult for you to judge, as you may lack (sufficient) experience with such types of journals and the articles they publish.

To help you with this, there is a very useful website: [www.eigenfactor.org](http://www.eigenfactor.org). Go to the *Eigenfactor Metrics*, indicated on the right of the page.

The image shows a screenshot of the Eigenfactor.org website. At the top, there is a navigation bar with links for HOME, PROJECTS, PAPERS, and ABOUT. Below this is a large network diagram with nodes representing various research areas such as Economics, Geography, Sociology, Education, Psychology, Psychiatry, Environmental Health, Medical Imaging, Neuroscience, Pharmacology, Agriculture, Crop Science, and Ecology & Evolution. A red arrow points to a box labeled 'The Eigenfactor Metrics' which describes it as a searchable database of Eigenfactor® and Article Influence® scores from 1997 to 2013. Below the network diagram, there are sections for 'RESEARCH AREAS' with sub-sections like 'Scholarly Publishing' and 'Mapping Science', and a 'Search Results' section with a search bar and a list of results including 'Economics', 'Law', 'Sociology', 'Probability and Statistics', and 'Sociology of Science'.

On the next page, fill out the journal name (note, any spelling mistake will result in no match) and press “find journal”. The page will proceed to the Journal Ranking information.

In selecting articles for your required additional material, **ONLY** use articles that have an **AI score of > 80**.

Note that these articles can be of various disciplines. Through the course, we draw from journals from Marketing, Management, Strategy and Psychology (e.g., Journal of Economic Psychology, Journal of Marketing; Journal of Personality and Social Psychology; Journal of Product Innovation Management; Management Science, etcetera), all of which can be an inspiration to you or serve as a starting point for your search. However, you are more than welcome to look beyond those journals and disciplines, as long as the articles are relevant and meet the >80 AI criterion.

## 9. PLAGIARISM

### 9.1 What is plagiarism?

If you do not include proper references in your work, you could be accused of plagiarism: passing off others' work, ideas or arguments as your own. Plagiarism is regarded as fraud and is taken very seriously in the academic world. If you commit plagiarism during your studies, you could face serious punishment including exclusion from a course or even expulsion from the university. For academics, plagiarism can mean the end of their career.

## 9.2 What is regarded as plagiarism?

The following are clear examples of plagiarism:

- Handing in somebody else's work as if it is your own.
- Copying passages, long or short, from a source without acknowledging it.

But the following also count as plagiarism:

- 'Borrowing' somebody else's words or ideas without acknowledgement.
- Making just a few changes to a text, graph or diagram and then claiming it as your own.
- 'Forgetting' to put quotation marks around a literal quote.
- Including an incorrect or incomplete reference, so that the source cannot be traced.
- Not including a reference every time you draw upon a particular source; this is equivalent to passing off part of the information used as your own work.
- Using so many words or ideas from a source that they make up the bulk of your paper – even if you do credit the source!

(Source: <http://webcursus.uvu.vu.nl>)

The university is very strict about the conduction of plagiarism. It can lead to exclusion of the Master of Marketing program without graduating. For these reasons, every written assignment is checked for plagiarism with the help of SafeAssignment in Canvas. Each lecturer has the obligation to provide the plagiarism score of the student's assignment.

It is observed that students in some cases do not exactly know that they have plagiarized. As a result, the university has developed an online course "How do I incorporate literature in my reports?" for students to participate in. Please note that this excludes the ability of students to protest that they were uncertain about the fact that they plagiarized.

Please check:

[http://libguides.vu.nl/b-business-admin/incorporating\\_literature](http://libguides.vu.nl/b-business-admin/incorporating_literature)

